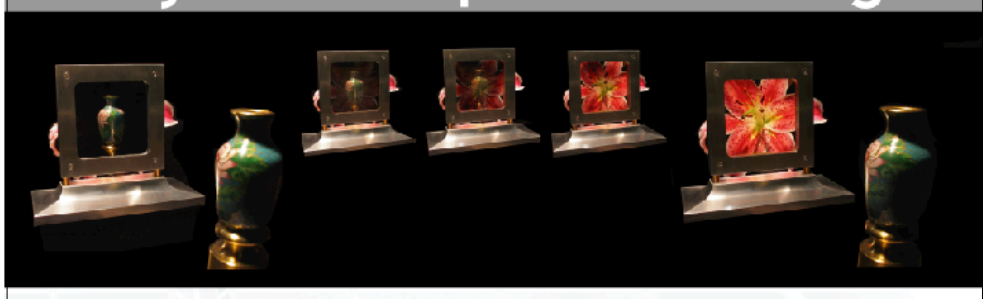
SMART WINDOWS
Dynamic Optical Coatings



A Smart Window Cycles Between Reflective and Transparent States

SMART WINDOWS CAN SAVE BILLIONS OF DOLLARS PER YEAR

- **Energy Efficient**
- **Control Heat and Light**
- **Optimal Comfort**

Can be used in:
- **Commercial/Residential Buildings**
- **Automotive**
- **Spacecrafts and Satellites**

2004 R&D 100 Award

Tom Richardson
Jonathan Slack

Building Technologies Department
Environmental Energy Technologies Division
Lawrence Berkeley National Laboratory

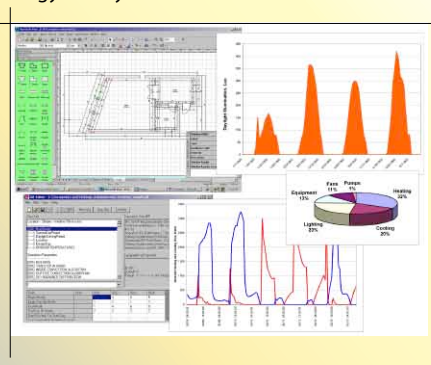
EnergyPlus
Building Energy Simulation Software

EnergyPlus is a new-generation computer program for design of energy-efficient buildings. It calculates the yearly energy use of any type of building—from a small house to a large office tower—given information on its construction, climate, orientation, and heating/cooling/lighting systems. It can simulate more aspects of building energy use than any other program.

The new San Francisco federal building, now under construction, was designed with the help of EnergyPlus. EnergyPlus showed that it is possible to cool much of this building by natural ventilation through openable windows, eliminating expensive mechanical air conditioning.

Many buildings worldwide are being designed by architects and engineers with the help of EnergyPlus, including the new World Trade Center. Using EnergyPlus can cost-effectively reduce a building's energy use by 25% or more.

EnergyPlus has been downloaded at no cost by thousands of users worldwide. It has been licensed to 50 collaborative developers and eight commercial distributors.



Screen images of a few of the EnergyPlus utilities, including import of building geometry from CAD programs (upper left), program to simplify data input (lower left), and graphical display of calculation results (right).

For more information, go to www.EnergyPlus.gov

Development of the EnergyPlus building energy performance simulation software was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, U.S. Department of Energy through the Building Technologies Program.

2003 R&D 100 Award Winner

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Environmental Energy Technologies Division

CLASP

the COLLABORATIVE LABELING and APPLIANCE STANDARDS PROGRAM

THE MISSION

The mission of the Collaborative Labeling and Appliance Standards Program (CLASP) is to:

Facilitate the adoption of energy efficiency standards and labels in developing countries, transforming the manufacture and sale of appliances, equipment and lighting worldwide.

Scope: Energy-efficient
- Test procedures
- Comparison labels
- Endorsement labels
- Minimum energy performance standards

THE PROBLEM

Growth in the demand for electric power is straining an inadequate energy infrastructure, causing environmental damage and hindering economic growth. World demand for major appliances and equipment accounts for an ever increasing portion of this steady growth in demand.

Without efforts to reduce energy consumption by appliances and equipment, electricity demand will continue to outstrip supply in the developing world.

Worldwide activities related to buildings (including appliances, equipment and lighting) accounts for:
- 34% of total energy consumption.
- 25-30% of energy-related carbon dioxide (CO_2) emissions.
- 10-12% of net contribution to climate change from all greenhouse gases.

THE SOLUTION

By setting limits on electricity consumed by appliances and equipment technologies, efficiency standards and labeling (S&L) programs can help meet rising energy demand.

The United States government has spent $2 per household on its standards program. By 2020, this will have:
- induced $900 investment per household by consumers in energy efficiency,
- brought energy bill savings of $2,400 per household,
- brought $1,500 per household net savings to the U.S. economy from fuel savings,
- reduced residential energy use in 2020 by 8% and carbon emissions by 37 million metric tons per year.

BUT: The benefits of S&L programs accrue over decades. Standards and labeling require a long-term energy policy perspective. It is most effective to focus on new products—85 to 90% of energy used 20 years from now will be used by products that have not yet been manufactured.

CLASP'S ACTIVITIES

CLASP is a global partnership founded in 1999 by Lawrence Berkeley National Laboratory (LBNL), the Alliance to Save Energy (the Alliance), and the International Institute for Energy Conservation (IIEC).

It provides:
- Country-level technical assistance to individual country governments interested in S&L development;
- Regional harmonization collaboration;
- Market analysis and research for baseline studies as well as monitoring and evaluation of program impacts;
- Turn-key educational and outreach tools that explain the common elements and strategies of successful S&L programs worldwide and help calculate potential program benefits; and
- Forums for information exchange such as regional workshops and seminars.

RECENT WORK

China—CLASP provides technical assistance to the Chinese government on standards for refrigerators, room air conditioners, clothes washers, color televisions, central air conditioners and motors.

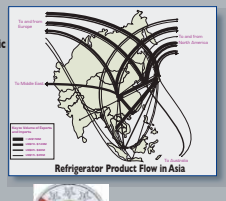
India—CLASP participates in the S&L process led by the Indian Bureau of Energy Efficiency.

Brazil—CLASP provides technical assistance to the government of Brazil for a potential refrigerator standard.

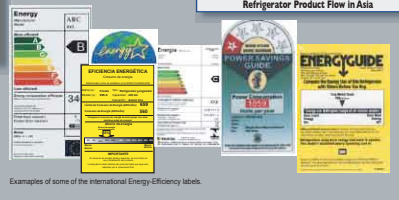
Asia—CLASP participates in S&L program discussions within the Energy Working Group of APEC.

South Africa—CLASP works with the Academy for Educational Development to involve the public in a national S&L program.

Mexico—CLASP assists local energy efficiency organizations—CONAE and IIE—in updating their impact assessment model.



Refrigerator Product Flow in Asia



Energy-Efficiency Labels and Standards: A Guidebook for Appliances, Equipment, and Lighting was published in February, 2001 and translated into Chinese, Korean, and Spanish in 2002 and 2003.

Examples of some of the international Energy-Efficiency labels.

For More Information, see: www.CLASPonline.org

PO_38b

Environmental Energy Technologies Division

Fuel Cell Research and Development at Lawrence Berkeley National Laboratory

Objective: To provide the technologies for the successful commercialization of polymer-electrolyte (PE) and solid oxide fuel cells for automotive and stationary applications.

Berkeley Lab scientists have been studying fuel cell technologies for 30 years. Current research is based in the Environmental Energy Technologies Division (EETD) and Materials Science Division (MSD). The Lab's expertise includes: Catalysis • Polymers • Modeling batteries and fuel cells Diagnostics, using electrochemical, spectroscopic, and microscopic methods.

Automotive Applications—Current Areas of Research

Platinum (Pt) Reduction

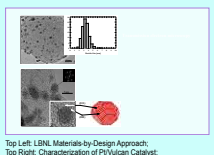
Philip Ross, MSD

Reducing the platinum in a fuel cell electrode will lower the cost per kilowatt, but it must be done without reducing the cell performance. The materials-by-design approach combines modeling the ideal Pt catalyst with the study of real Pt catalysts. It seeks to develop optimized electrodes by adjusting the size and shape of Pt particles, and replacing some platinum with other metals, such as cobalt without affecting catalytic activity

Modeling

John Newman, University of California, Berkeley, and EETD

The purpose of computer modeling of fuel cells is to improve polymer-electrolyte fuel cell design. Modeling can for example, help optimize electrode porosity and thickness, and characterize the transport of ions through channels in the membrane. Advanced mathematical models are being devised to understand the conditions and mechanisms that lead to electrode and membrane failure, stress effects, and delamination of the membrane from catalyst layers.



Top Left: LBNL Materials-by-Design Approach;
Top Right: Characterization of Pt/Vulcan Catalyst;
Bottom: Plantinum Skin Effect: catalytic activity of Pt "skin" for ORR.

Advanced Catalysts for Electrodes

Robert Kostecki, EETD

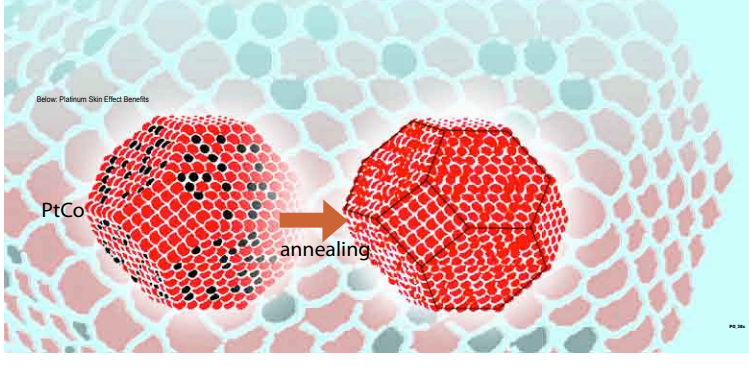
Fuel cells lose efficiency because of poor oxygen electrode kinetics. Platinum has been shown to be the best catalyst, but it is expensive. Current research focuses on reducing platinum mass while increasing its effectiveness as a catalyst by developing high-surface area material. New electrodes are being designed to optimize the transport of protons, electrons and oxygen to the catalysis site in order to maximize reaction efficiency

Advanced Polymers for Membranes

Nitash Balsara, EETD

PE fuel cells need to operate at high temperatures, above 120°C, in order to be feasible in practical applications. The fuel cell membrane serves as the reaction's proton source. This work involves building and testing nanostructured membranes in which the mechanical and transport properties can be independently controlled. The research pioneers the use of the self-assembly of block copolymers, a promising membrane material possessing channels that can improve ionic conductivity

Below: Platinum Skin Effect Benefits



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